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**CONTRIBUTO ALLA CONOSCENZA MALACOLOGICA PER IL
NORD DELL'ISOLA DI CIPRO
(Parte II)**

KEY WORDS: Mollusca, Gastropoda, Distribution, North Cyprus,

Riassunto

Con questo secondo contributo sulla conoscenza della fauna malacologica del Nord di Cipro, vengono presentati due ospiti tropicali poco conosciuti, solo da pochi anni penetrati nel nostro mare: *Clathrofenella fusca* (A.Adams, 1860) e *Metaxia bacillum* (Issel, 1869). Viene inoltre anche segnalata *Alvania* (*Crisilla*) *chiarellii* n. sp.

Summary

This new contribution to the knowledge of the Malacological fauna of Northern Cyprus, deals with two little known tropical species of recent penetration in to the Mediterranean Sea: *Clathrofenella fusca* (A.Adams, 1860) and *Metaxia bacillum* (Issel, 1869). *Alvania* (*Crisilla*) *chiarellii* n.sp. is described.

Introduzione

Nell'abbondante quantità di materiale, ancora in studio, da noi raccolto a Cipro sono presenti molte specie interessanti fra le quali intendiamo segnalare in questa nota: *Clathrofenella fusca* (A.Adams, 1860) e *Metaxia bacillum* (Issel, 1869), due specie dell'Indo Pacifico che risultano penetrate recentemente nel Mediterraneo attraverso il Canale di Suez (BARASH AL. & DANIN, 1977; MIENIS, 1985; AARTSEN et al.1989). Viene pure istituita *Alvania* (*Crisilla*) *chiarellii*, nuova specie appartenente alla famiglia Rissoidae Gray,1847, tipica di Fethiye (Turchia) e presente anche a Cipro.

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***Clathrofenella fusca* (A.Adams, 1860)**

(Tav. 1, figg. 2, 2a)

Sinonimi:

- ? *Melania* Audouin, 1827
- Rissoa cerithina* Philippi, 1849
- Dunkeria asperulata* A.Adams, 1860
- Dunkeria ferruginea* A.Adams, 1860
- Dunkeria fusca* A.Adams, 1860
- Dunkeria reticulata* A.Adams, 1860
- Alvania cerithina* Issel, 1869
- Fenella cerithina* Tryon, 1887
- Fenella orientalis* Yokoyama, 1920
- Fenella reticulata* Makiyama, 1929
- Clathrofenella reticulata* Kuroda & Habe, 1952
- Clathrofenella reticulata longa* Oyama, 1954
- Clathrofenella asperulata* Habe, 1961
- Clathrofenella fusca* Habe, 1961

Discussione

Abbiamo ritenuto opportuno illustrare questa specie di origine tropicale che da poco si è introdotta nel nostro mare (BARASH AL. & DANIN, 1977).

Clathrofenella fusca (A.Adams, 1860) è caratterizzata dalla conchiglia piccola di colore castano chiaro, leggera, turricolata, con apice appuntito. La protoconca è composta da 2,5 giri lisci e lucidi; la superficie ha la particolarità di avere da 3 a 5 robuste coste spirali separate da coste assiali che formano una scultura reticolare tipica di questa specie. Negli esemplari freschi sono visibili tra la scultura cancellata sottili linee tratteggiate di colore ruggine. L'apertura è ovale con un debole angolo anteriore.

Molto comune nell'Indopacifico si rinviene nella sabbia e su fondali melmosi a -5 / -30 m (HABE, 1961); segnalata in Giappone (HABE, 1970), Golfo Persico (BIGGS, 1973) e mar Rosso (ISSEL, 1869:206); ha avuto una travagliata sinonimia dovuta attendibilmente alla sua variabilità, ed è più comunemente conosciuta come *C. reticulata* (A.Adams, 1860). Ha una distribuzione molto vasta ed ha già superato, dopo l'apertura del Canale di Suez (1869), il 35° parallelo raggiungendo le coste israeliane (Haifa Bay) e siriane (BARASH AL. & DANIN, 1977) ed ora, anche il Sud della Turchia e il Nord di Cipro.

Forse a ragione della obiettiva difficoltà che si può incontrare nel separare questa specie da alcune varietà di forme presenti in specie del genere *Bittium* Gray, 1847, è giustificato che da oltre venti anni non ci risultano, oltre alle segnalazioni di BARASH AL. & DANIN (1977) per il mare di Levante, successive conferme bibliografiche, ma solo sporadiche segnalazioni personali. È quindi da accettare l'ipotesi che *C. fusca* sia sovente sfuggita all'identificazione e per tale motivo riteniamo utile raffigurare per eventuali raffronti, gli esemplari da noi raccolti a Cipro (fig. 2, 2a). Ne sono

stati separati una dozzina, quasi tutti in ottimo stato di conservazione, il che lascia supporre che la specie in questione sia già ben diffusa e acclimatata nel Mediterraneo.

Oltre alle illustrazioni di BARASH AL. & DANIN (1977), di TRYON (1887) e quelle di SAVIGNY riprese da PALLARY (1926), abbiamo fatto riferimento, per una sicura identificazione degli esemplari da noi ritrovati, anche al lavoro di KURODA & HABE (1952) e alle illustrazioni di KURODA & HABE (1971) e HABE (1961) e soprattutto HABE (1977) dove vengono trattati i tipi descritti da A.Adams (1860) per i mari giapponesi, attinenti ai generi *Dunkeria* e *Fenella*, conservati nel British Museum (National History) di Londra e visionati personalmente da MAKIYAMA nel 1929.

HABE (1977) mette in sinonimia con *Clathrofenella fusca* (A.Adams, 1860) *Dunkeria asperula* (A.Adams, 1860) e *D. reticulata* (A.Adams, 1860), che pur presentando caratteristiche diverse, evidenziate nei disegni dell'Autore, rientrano nella variabilità della specie. Egli considera conspecifiche anche *Dunkeria ferruginea* (A.Adams, 1860), *Fenella orientalis* (Yokoyama, 1920) e *Clathrofenella reticulata longa* Oyama, 1954. Alle sinonimie aggiungeremmo anche *Rissoa cerithina* Philippi, 1849 di cui MOAZZO (1939:189) dà una chiara riproduzione evidenziando le stesse caratteristiche morfologiche di *C. fusca*; e per confronto, abbiamo iconografato un esemplare del Mar Rosso (Suakin Island – Sudan, fig. 2b).

Infine, si è voluto presentare anche una interessante forma di *Bittium jadertinum* (Brusina, 1865) (fig. 3), e due fasi giovanili (fig. 3a, 3b), sempre di *B. jadertinum* per poter meglio mettere in evidenza le differenze con *C. fusca*.

***Metaxia bacillum* (Issel, 1869)**

(Tav. 1 fig. 1)

Sinonimi:

? *Terebra* Audouin, 1827

Cerithium bacillum Issel, 1869

Cerithium (*Cerithiopsis* ?) *bacillum* Issel, 1869

Cerithiopsis bacillum Mac Andrew, 1870

Bittium bacillum Pallary P., 1926

Metaxia bacilla Mienis, 1985

Discussione

SAVIGNY (1817: tav.4, fig. 28) raffigura una specie di *Cerithium* Bruguière, 1789 includendola tra le conchiglie viventi nel Mar Rosso. ISSEL (1869: 151 sp. n. 357), basandosi sull'illustrazione di SAVIGNY, ritiene di identificare questa conchiglia con esemplari fossili da lui raccolti sulle spiagge emerse del golfo di Suez e ne dà una diagnosi che sarà ripresa e accettata da TRYON & PILSBRY (1887, pl.36, fig.63). BOUCHET & DANRIGAL (1982: tav.21, fig. 77), raffigurando i tipi della collezione SAVIGNY, ne danno una chiara iconografia, rendendo palesi particolari strutturali tipici evidenziati da ISSEL nella diagnosi. Conchiglia minuta, allungata, turricolata, trasversalmente costata; giri alquanto convessi, regolarmente crescenti, divisi da su-

ture ben distinte ed ornati da quattro coste. Apertura verticale angolosa, labbro arcuato, semplice ed acuto.

Osservando le peculiari coste spirali molto pronunciate che rendono questa specie strutturalmente vicina al genere *Seila* A.Adams, 1861 si è portati a mettere in dubbio l'appartenenza al genere *Metaxia* (Monterosato, 1884), ma è la protoconca dalla forma apicalmente stiloide ornata da linee spirali a zigzag, il carattere che contraddistingue questo genere (THIRIOT-QUIEVREUX C. & BABIO R., 1975: 142; MARSHALL, 1977: 111; BOUCHET, 1984:17); per questa ragione, conoscendo le difficoltà nel volere esaminare un esemplare con l'apice praticamente integro perché facile alla rottura, e quindi essere certi della vera identità di *Metaxia bacillum*, abbiamo esaminato un esemplare con un lievissimo difetto apicale presente nella coll. G. Buzzurro (Monza - Milano) raccolto a Shiqmona (Israele) e un frammento con la protoconca quasi perfetta, proveniente dalle coste litorali a Sud della Turchia (Kiakalesi), ex coll. W. Engl -Düsseldorf (Germania), pervenendo alla conclusione sulla effettiva validità attribuitagli da MIENIS (1985).

Scarse le informazioni rese note sui ritrovamenti da MIENIS (1985) e AARTSEN et al. (1989) per le coste di Israele. Provenienti dalle coste a sud della Turchia, loc. Tasuçu -6m e dal litorale israeliano, abbiamo esaminati altri esempl. presenti nella coll. G. Buzzurro e due della coll. E. Greppi (Castellanza-Varese); n. 1 esemplari nelle collezioni private di S. Palazzi (Modena); L. Giunchi (S.Zaccaria Ravenna) e Di Massa (Trieste) loc. Iskenderun (Turchia). Per un raffronto abbiamo voluto verificare anche alcuni esemplari provenienti dal Mar Rosso (coll. I. Perugia Pavia), purtroppo detriti.

Si segnala quindi il ritrovamento di alcuni frammenti e un esemplare (Tav. 1 fig. 1) di *Metaxia bacillum* (Issel, 1869) anche per il nord dell'isola di Cipro; questa specie, poco comune nel Mar Rosso si sta acclimatando ora anche in Mediterraneo.

Tavola 1

Fig. 1 *Metaxia bacillum* (Issel, 1869)

H 5,01 mm loc. Iskenderun (Sud Turchia)

Fig. 2, 2a - *Clathrofenella fusca* (A. Adams, 1860)

H 3,01-2,98 mm loc. Kirenia (Nord Cipro) - 10m;

Fig. 2b - *Rissoa cerithina* Philippi, 1849

= *Clathrofenella fusca* (A. Adams, 1860)

H 3,60 mm loc. Saukin Island - Sudan - Mar Rosso

Fig. 3, 3a, 3b - *Bittium jadertinum* (Brusina, 1865)

H 4,00 mm esempl. con particolare scultura,

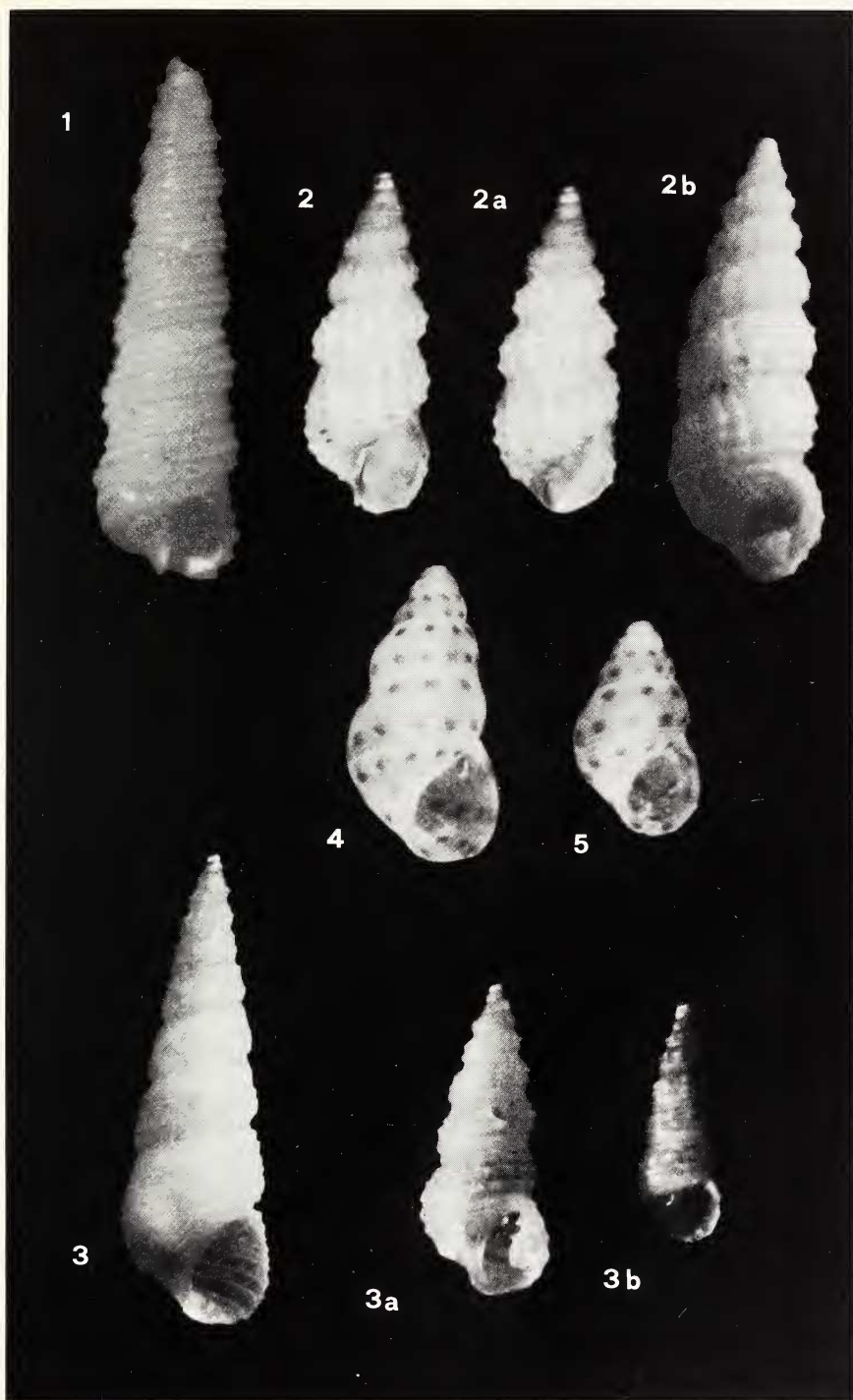
(a 2,8 mm) (b 2,2 mm) loc. Kirenia (-m)

- Fig. 4 - *Alvania (Crisilla) chiarellii* n.sp.,

H 2,21 mm loc. Kirenia (-10m);

- Fig. 5 - *Alvania (Crisilla) beniamina* (Monterosato, 1884)

H 1,60 mm loc. Kirenia (-10m);



***Alvania (Crisilla) chiarellii* n.sp.** (Tav. 1 fig. 4, & tav. 2)

Descrizione dell'olotipo. — Altezza 2,21 mm Larghezza 1,15 mm (fig. 4). Piccola conchiglia di forma conica, minuta, vitrea negli esemplari freschi. La protoconca è ottusa con il nucleo embrionale di un giro e mezzo finemente striato. La teleoconca ha aspetto liscio, ma a forte ingrandimento è visibile un reticolo di strie di accrescimento e spirali. È composta da 4/4,5 giri poco convessi inferiormente ornati da due o tre cordoncini irregolarmente spazati. Con la crescita, l'inferiore viene inglobato in una sutura incisa che risulta bordata dai cordoncini superiori. L'ultimo giro occupa poco più della metà della conchiglia (61%). L'apertura subrotonda possiede un fine callo columellare; il labbro è sottile e fragile. Sulla colorazione di fondo, giallo-paglierina, sono presenti serie regolari di macchioline subquadrate color ruggine, due sulla spira e due sulla base, queste ultime visibili solo sull'ultimo giro. La trasparenza del nicchio lascia intravedere il disegno anche dall'interno.

Esemplari esaminati e collocazione dei tipi.

Sono stati esaminati oltre 200 esemplari provenienti da un campione di detrito leggermente fangoso raccolto in grotta a -44,5 m di profondità in località Fethiye (Turchia) nell'Agosto 1992. Sempre a Fethiye; altri tre paratipi raccolti alla base di una parete rocciosa su un fondale detritico a -27 m di profondità, tutti questi presenti in coll. S.Chiarelli (Porto Garibaldi -FE).

Quindici paratipi coll. P. Quadri (Milano) e quattro esempl. coll. A. Cecalupo (Milano) rinvenuti a dieci km e Est di Kyrenia su un fondale grossolano di tipo coralligeno in posidonieto -4 / -10 m; ; quattro esempl. coll. L. Giunchi (San Zaccaria -RA-) da Salamis (Golfo di Famagosta) Nord Cipro; due esempl. da Fethiye nelle coll. S. Palazzi (Modena) e F. Giusti (Livorno); due esempl. coll. P. Micali. (Fano -PS-) da Kyrenia.

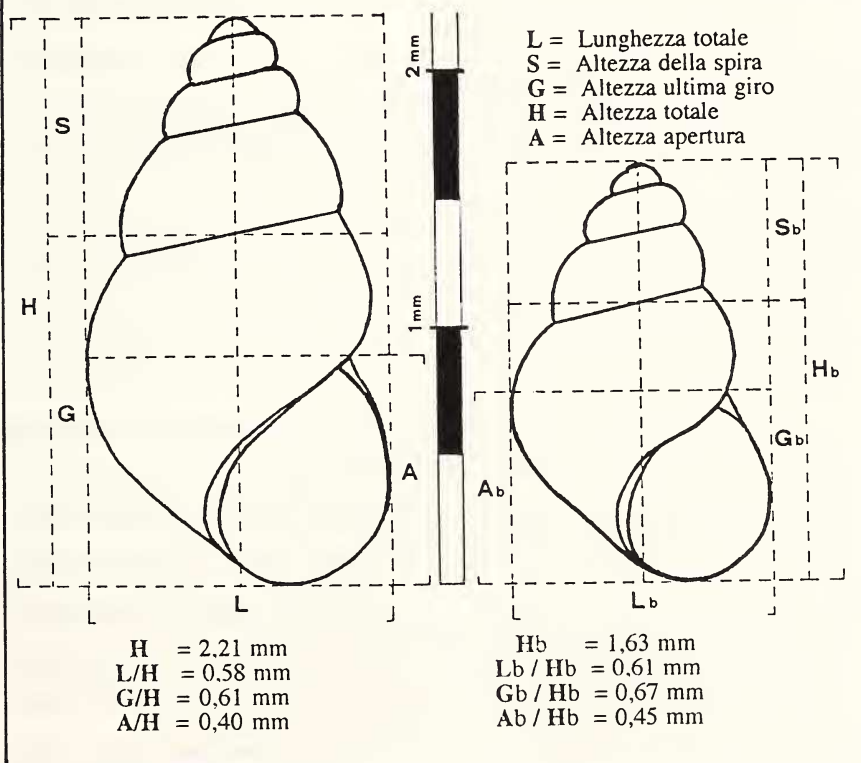
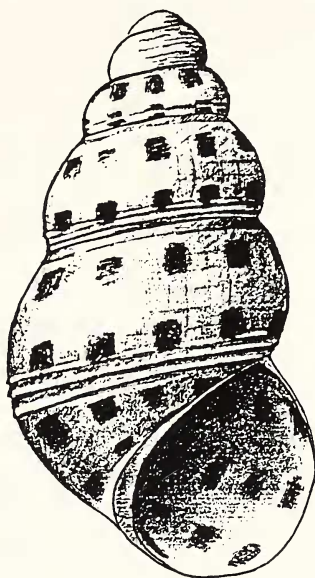
L'olotipo di *Alvania chiarellii* sarà depositato presso il Laboratorio di Malacologia del Museo di Zoologia dell'Università di Bologna.

Località tipica — Fethiye (Turchia).

Discussione

A prima vista *Alvania (Crisilla) chiarellii* (fig. 4 tav. 1) presenta tutte le caratteristiche del sottogenere *Crisilla* Monterosato, 1917 (1). La più simile fra esse è *Alvania (Crisilla) beniamina* (Monterosato, 1884), presente in tutto il Mediterraneo, e che è stata trovata simpatica con *A. chiarellii* in alcune delle località precitate (Fethiye, Kyrenia). Va rilevato che *A. beniamina* è ovunque specie poco variabile ed anche se presenta caratteri che la possono far confondere con *A. chiarelli* allo stato giovanile, da adulti i nicchi si presentano notevolmente diversi. La prima è innanzitutto più piccola — 1,2 mm a 1,7 mm (VERDUIN, 1984) — e presenta una protoconca poco acuta e un ulteriore più sottile cordoncino posto immediatamente al disotto dei puntini sottosuturali, ma quello che risulta evidente è la diversa conformazione di apertura e forma dei giri, la maggiore elevazione dovuta al diverso rapporto lunghezza larghezza, nonché la minor lunghezza relativa dell'ultimo giro. Per meglio evidenziare queste caratteristiche si riproducono nella Tav. 2 i contorni delle due specie.

(1) In merito alla posizione generica di *Alvania chiarellii* abbiamo seguito la sistematica proposta da PONDER (1985) e accettata da SABELLI *et al.* (1990-1992).



Tav. 2 – Sono riportate in scala le differenze strutturali e i contorni, tra *Alvania (Crisilla) chiaraellii* n.sp. e *Alvania (Crisilla) beniamina* (Monterosato, 1884).

Derivatio nominis:

Abbiamo voluto dedicare questa specie al nostro amico Stefano Chiarelli di Porto Garibaldi (Ferrara) Italia, che ci ha permesso, con l'esame del materiale da lui raccolto in Turchia, di identificare questa nuova *Alvania*.

Ringraziamenti

Desideriamo ringraziare Stefano Palazzi per il gentile aiuto prestato, e per la lettura critica del manoscritto di *Alvania (Crisilla) chiarelli* n. sp.

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**QUALITATIVE AND QUANTITATIVE DISTRIBUTION OF BENTHIC
MOLLUSCS ALONG THE TURKISH BLACK SEA (**)**

KEY WORDS: Benthic Molluscs, Distribution, Turkish Black Sea.

Abstract

Single quantitative samples of soft-bottom benthos were collected using a van Veen grab (0.1 m²) from 20 localities along the Turkish coasts of the Black Sea in August-September 1988 and January 1989. A total of 25,674 specimens of molluscs were collected, belonging to 37 species of Gastropods and Bivalves. The total biomass was of 2361.7 g. Most important species in abundance and frequency were *Modiolula phaseolina*, *Mytilus galloprovincialis*, *Abra alba* and *Plagiocardium papillosum*.

Sommario

Nell'agosto-settembre 1988 e nel gennaio 1989, impiegando una draga van Veen (0,1 m²) sono stati effettuati singoli campionamenti di benthos mobile in 20 stazioni lungo le coste turche del Mar Nero. Furono raccolti in totale 25.674 esemplari di molluschi, appartenenti a 37 specie diverse di Gasteropodi e Bivalvi. La biomassa totale fu di 2361,7 g. Le specie più importanti per abbondanza e frequenza risultarono *Modiolula phaseolina*, *Mytilus galloprovincialis*, *Abra alba* e *Plagiocardium papillosum*.

Introduction

The number of the living macrozoobenthic species occurring in the Black Sea amounts to 1,785 of which 174 are Molluscs (BACESCU et al., 1971). This scarce colonization is due to complex hydrographical factors of this basin, but it can vary according to the different regions.

Few data are available on the mollusc fauna of the southern Black Sea. Firstly, OSTROUMOV (1893; 1896; cf. ZENKEVICH, 1963) studied the benthos present in the first 20 m in the Strait Bosphorus, but ZERNOV (1913; cf. ZENKEVICH, 1963) was the first to study quantitatively the benthic communities present in the Black Sea. More recently, DEMIR (1954) studied the benthic marine invertebrates of the Turkish Straits and Islands in the Sea of Marmara.

Material and Methods

The processing (sieving, sorting, preserving, weighing etc.) of the soft-bottom samples were made according to the STIRN's (1981) recommendations. The analytical methods (frequency, occurrence and dominance) used in this study were based on those of HOLDEN & RAITT (1974). Frequency is expressed as the percentage of total frequency of each species within total frequency of all species in the sampling area. The occurrence is defined as the total individual percentage of each species among total individuals of all species in whole studied region. Finally, the qualitative distribution or occurrence percentage of each species among stations is the dominance.

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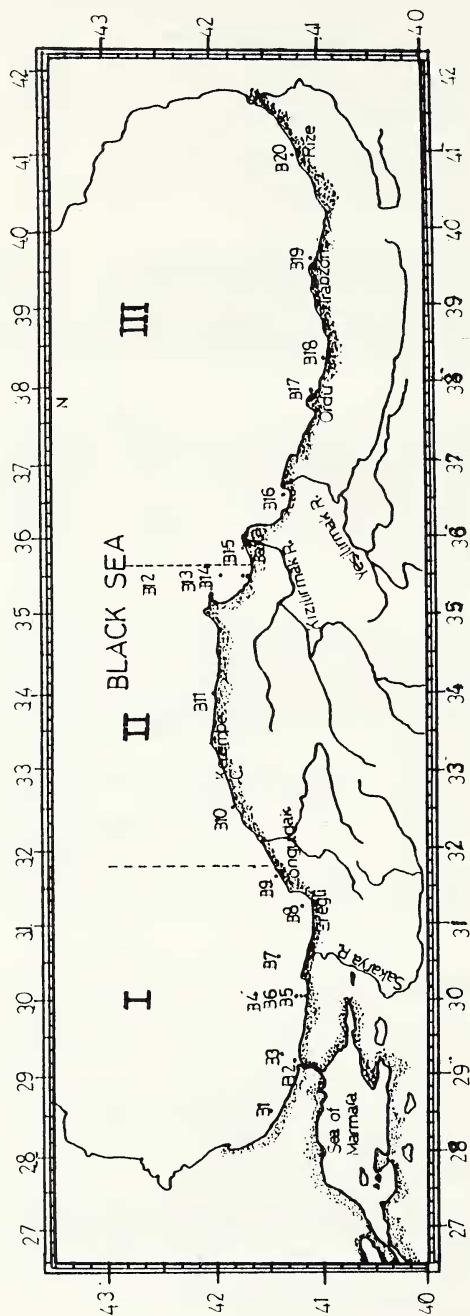


Figure 1: Map showing the locations of the benthic sampling stations in the Black Sea.

Results and Discussion

Qualitative distribution and species composition

This preliminary study yielded 36 taxa of Molluscs from the Turkish coasts of the Black Sea.

Gastropoda Prosobranchia: This subclass is represented by 26% species dominance in the whole sampling area. In this study, only 11 gastropods could be found, although 96 species were recorded from the Black Sea (ZENKEVICTH, 1963).

The sandy and muddy bottoms ranges from 15 to 30 m in the Black Sea and are inhabited by many molluscs and the species belonging to the genera *Nassarius* and *Pusillina* are considered the common gastropods of this zone in the Black Sea (SOROKIN, 1983). Moreover gastropods are frequent in the phaseolin ooze at a depth of more than 40 m (BORCEA, 1936; cf. ZENKEVICTH, 1963). According to SHOPOV (1978) along the Bulgarian coasts, *Bittium reticulatum* is frequently observed at depths of 30-40 m, where it is accompanied by *Ventrosia ventrosa*.

In the present study carried on along the Turkish coasts, 7 proso-branches (Figs. 2-4) were collected and *Trophon muricatus*, *Bittium reticulatum* and *Ventrosia ventrosa* can be considered common at Stations B7, B10 and B16, in depths ranging from 35 to 80 m. The last two species were found at five stations, where they are very dense at depths of 40-48 m. The more rare *Cyclope neritea* was sampled at the Station B 14, at 28 m depth.

The station B15, close to the delta of the Kizilirmak River, off Bafra, is rich in species. The water input of this stream may contain enough nutrients for the phytoplankton and this favour the macrozoobenthic filter-feeders. Another factor which could explain the occurrence of more macrobenthic species near the mouth of the river is the existence of coarse material in this area. In fact, the sediment texture in the coastal waters is controlled by the surface currents and the superficial sediments contain a large amount of coarse material.

Gastropoda Opisthobranchia: Only four opisthobranchs were identified from this area. Of these species, *Retusa truncatula* was frequently sampled (Figs. 2-3) and found at 35% of the stations. This species usually prefers silty clay bottoms.

According to SHOPOV (1979), along the Bulgarian coasts, *Retusa truncatula* and some other gastropods, e.g. *Ventrosia ventrosa* and *Trophon muricatus*, lives in greenish grey mud, at depths of 30 to 60 m, in the so-called *Ventrosia ventrosa* community (KRISCHEV & SHOPOV, 1978).

Other opisthobranchs found more rarely in the investigated area were *Chrysallida obtusa* and *Cylichnina umbilicata* (= *Retusa umbilicata*) (Figs. 2-3).

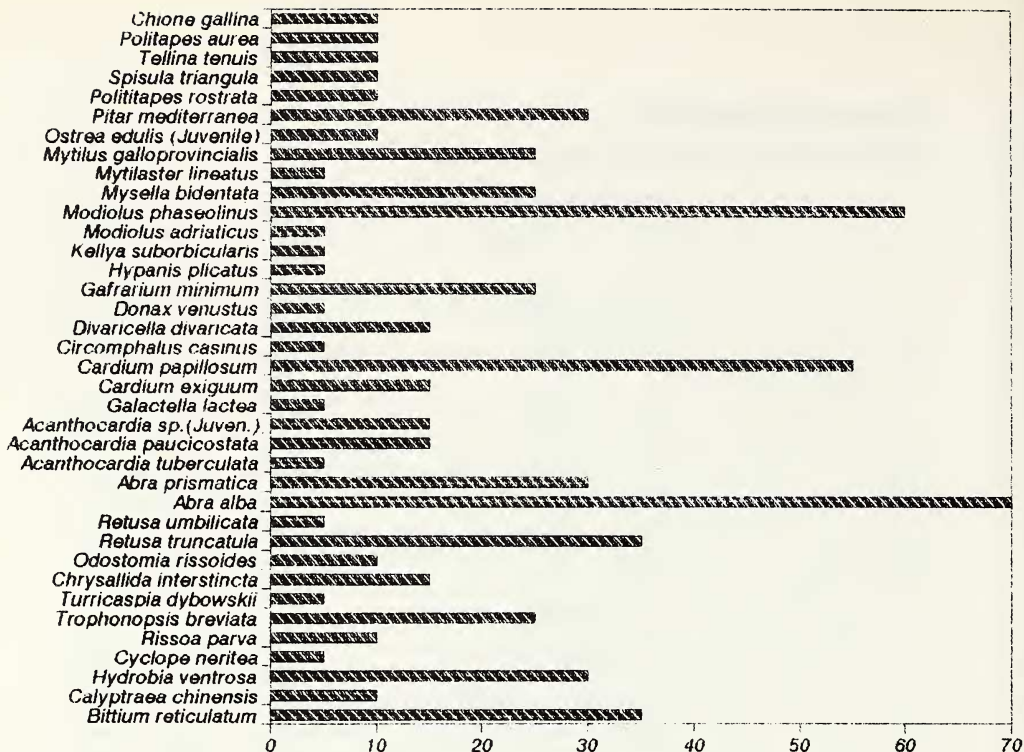


Figure 2: Dominance of species. %

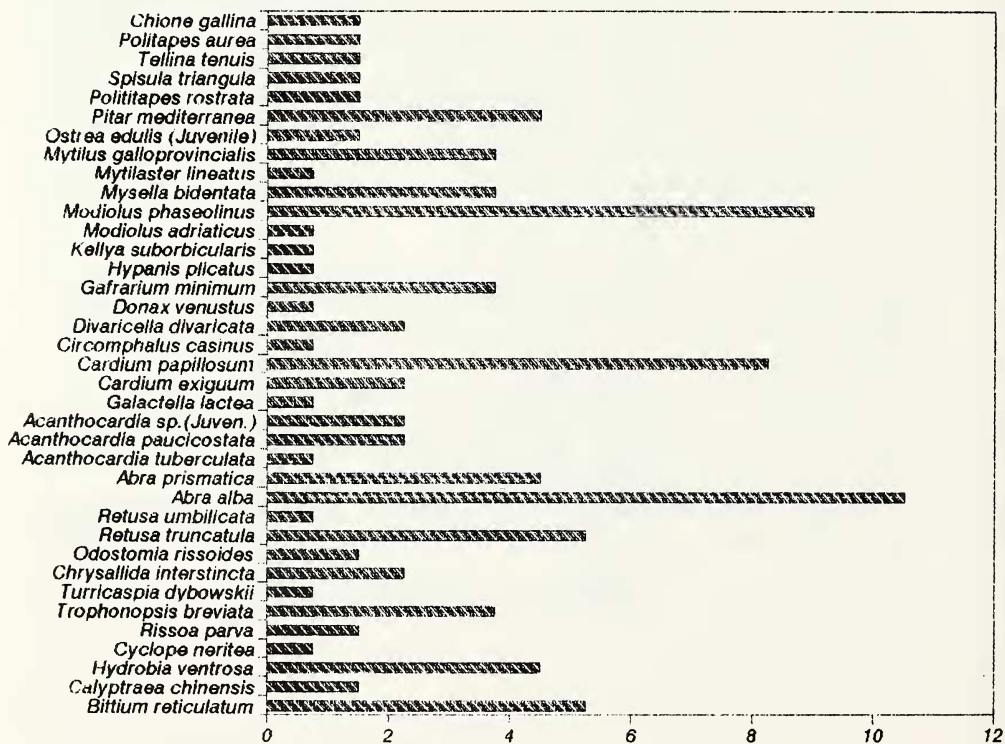


Figure 3: Frequency of occurrence among the species. %

Bivalvia: Bivalves are the largest class, with 25. collected species which constitute 70% of all species collected throughout this study along the southern Black Sea coasts. Until now 49 species of bivalves were recorded in the Black Sea (CASPER, 1957; ZENKEVITCH, 1963).

The most frequent recorded species were *Abra alba*, *Plagiocardium papillosum* and *Modiolula phaseolina* (Figs 2-3). Among these, *Abra alba* was identified in the 70% of the stations. This species lives at a depth ranging from 28 m to 112 m. Such species, particularly *Abra alba* and *Plagiocardium papillosum* inhabit the mussel mud present between 10 to 30 m and mostly the phaseolin ooze, extending from 55 m to 180 m in the Black Sea (YAKOBOVA, 1935; cf. ZENKEVITCH, 1963). Also BORCEA (1936; cf. ZENKEVITCH, 1963) pointed out that such bivalves could generally dwell in the phaseolin ooze which extends from 55-65 m to 180-185 m depths along the continental shelf of the northern coasts of the Black Sea. At this depth, the type and texture of the bottom sediment are silt or silty mud which was deposited by the fecal pellets of its own filter-feeding bivalve: *Modiolula phaseolina*. This species is an interesting example of the ecological aspects of the Mediterranean fauna in the Black Sea. It is relatively rare in the Mediterranean Sea, but commoner in the Atlantic Ocean as far as to Norway, and particularly abundant off the shores of England (ZENKEVITCH, 1963). In the Black Sea, it occurred most frequently at depths of 65 to 100 m on the soft bottom, not rising above 40 m and not sinking below 180 m (JAKUBOVA, 1948; cf. ZENKEVITCH, 1963).

On the shelf bottom, *Mytilus galloprovincialis* was observed especially at depths less than 40 m. Offshore Eregli and Bafra, this mussel lives generally between 20 to 40 m depth.

M. phaseolina begins to re-appear below 50 m and extends to 150-160 m along the Rumanian coasts (BACESCU et al., 1971). *Abra alba* is well concentrated in the shallower waters of Sulina and Odessa where there is a river discharge to the Black Sea (BACESCU et al., 1971).

Other not so common bivalves are: *Lucinella divaricata*, *Chamelea gallina*, *Donax venustus*, *Venerupis aurea* and *Mytilaster lineatus* (Figs. 2-3). These species were mainly found at station B 20 at 20 m depth close Rize, where the sea bottom is sandy (93%). ZENKEVITCH (1963) classified some molluscs as characteristic of the sandy bottoms of the Black Sea: *Chamelea gallina*, *Gouldia minima*, *Lucinella divaricata*, *Spisula subtruncata*, *Parvicardium exiguum* and *Pitar rudis*. The fine sand bottoms along the Russian coasts between 15 to 28 m depth are well-inhabited by these species (CASPER, 1957) and a similar fauna was described along the Rumanian coasts, between 6 and 15 m (BORCEA, 1927; cf. CASPER, 1957). From the results of the study carried out by BACESCU et al. (1971). in the Rumanian sector, *Gouldia minima*, *Lucinella divaricata* and *Chamelea gallina* were mostly located around a depth of 20 m, off the Varna.

Apart from these bottom types, a gravel substratum containing 73 % of gravel in its sediments (Tab. 3) was observed only at station B 2. Only one species, *Striarca lactea* was sampled. This species was reported by DEMIR (1954) to dwell on the shelly-gravel substratum.

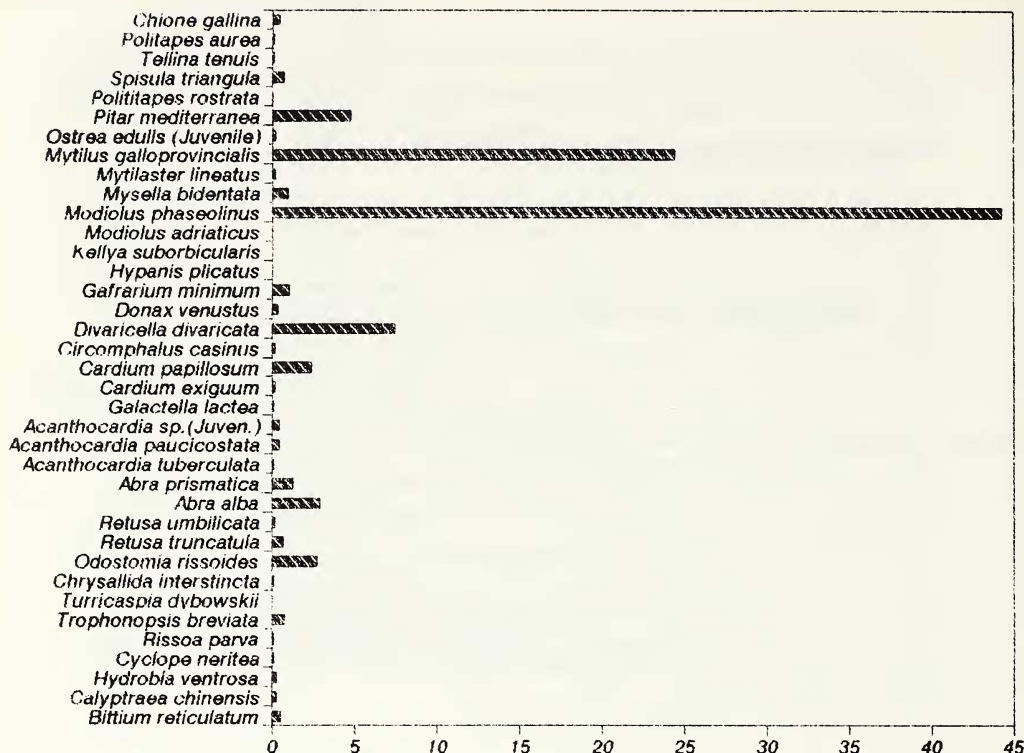


Figure 4: Numerical occurrence of the species. %

Maximum species number (20 spp./m²) was found at station B 14 (Fig. 1) and at Station B 15 (19 spp./m²). These stations are placed at the depths of 28 and 36 m respectively, around the river of Kizilirmak off Bafra in the middle part of the southern Black Sea. They have a silty bottoms, but the sediment texture of station B15 is more homogeneous than that of station B14. The stations B20 at 40 m, B8 at 34 m, B5 at 58 m and B6 at 44 m have had 11, 12, 10 and 10 species per m², respectively. The stations in the off-shore region, such as B7 and B12, have less species and B3 had no species (Tab. 4). Hence, the species number of coastal waters was greater than that of the open water. Depending on the depth of the stations, the species number increases from the west to the east in the studied area. The stations which are close to delta front of the rivers, such as B15 and B16 are rich in the dissolved oxygen content, in detritus and in sinking nutrient materials. This is very important for such filter-feeders as many bivalves. The oxygen content of station B 6, containing moderate number of species (13) was 6.79 ml/l. The stations in deep waters with a low oxygen content are found to have low species number. For example, the locations having the oxygen content between 1 and 3 ml/l had 1 to 4 mollusc species. At the stations where the waters have low oxygen content, three common species, *Modiolus phaseolina*, *Abra alba* and *Plagiocardium papillosum*, were found. In a study carried out by DRIES (1978), it was announced that *Abra alba* can

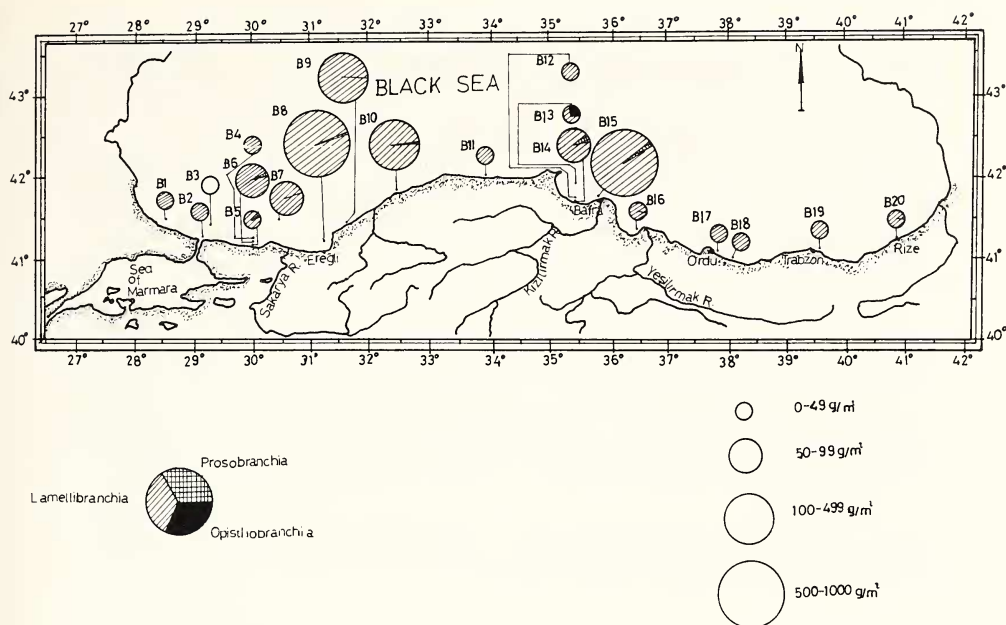


Figure 5: Map showing total biomass contribution of macrobenthic mollusc subclasses at the sampling stations (From MUTLU et al., 1993).

activate metabolic functions under oxygen deficiency. It was pointed out that the utilization of the food reserves during the exposure to anaerobic water and the recovery of respiration after oxygen deficiency were determined for *Abra alba*.

As a result, the species number and composition could depend on several environmental factors. In this study, the molluscs decrease when the depth increases, but increase with the dissolved oxygen content of the deep waters.

Quantitative distribution

In the material collected at all stations in the southern Black Sea (20 m²), 37 mollusc species had 25,674 individuals and yielded 2361.25 g of biomass.

Gastropoda: Gastropods were represented by only 11 species and by 7.49% of the total biomass. The total abundance was 1,483 individuals in all sampling area. Prosobranchs was found to have 7 species: *Bittium reticulatum*, *Ventrosia ventrosa* and *Trophon muricatus*, generally inhabiting the phaseolin mud (usually at depth 40 to 130 m), were the most abundant species. The maximum biomass (Fig. 5) and abundance for these small gastropods were as follows: *Trophon muricatus*: 2.4 g/m², 80 ind./m² at station B15; *Bittium reticulatum*: 97 mg/m², 63 ind./m² at station B15 (36 m) and *Ventrosia ventrosa*: 41 mg/m², 29 ind./m² at station B8 (34 m).

This last species, in the Azov Sea inside the «*Ventrosia ventrosa community*» reaches 14,321 ind./m² with a biomass of 14.85 g/m² (CASPER, 1957). In the Bulgarian coasts, it constitutes 61.6% of the total abundance inside the same community at 30-60 m depth (SHOPOV, 1973).

The *Bittium reticulatum* was encountered by the 19.4% of the total abundance in the «*Spisula subtruncata community*» which was concentrated between the depths of 30-45 m along the Bulgarian coasts (SHOPOV, 1979). *Trophon muricatus* was found to have the maximum abundance (440 ind./m²) at the depths of 50-60 m along the Rumanian coasts and it almost disappeared (1-10 ind./m²) below 40 m depth (BACESCU et al., 1971).

Among Opisthobranchs, *Odostomia scalaris* was the most abundant (Fig. 4) although it was identified at only two stations (B5 and B15). The species biomass was weighed as 170 mg/m² (145 ind./m²) at station B5 (94 m) and 857 mg/m² (566 ind./m²) at station B 15 (36 m) along the Anatolian coasts of the Black Sea. The second species, *Retusa truncatula*, was found to have the maximum number (46 ind./m²) and 46 g/m² at station B15.

BACESCU et al., (1971) reported that *Odostomia scalaris* was generally sampled in the west and the northwestern parts of the Rumanian coasts. *Retusa truncatula* often appeared between 40-50 m depths along the Rumanian coasts especially offshore Sulina.

Bivalvia. The total biomass and abundance of the bivalves, with the 25 species, was recorded as 2.4 kg and 24,191 specimens in the whole sampling area (20 m²).

The most abundant species were *Modiolula phaseolina* and *Mytilus galloprovincialis* (Fig. 4). Such bivalves are known as fouling organisms (DOLGOPOL'SKAYA, 1954; cf. ZENKEVICH, 1963). *M. phaseolina* biomass is 660 g with 11,377 specimens, while *M. galloprovincialis* biomass is 1,486.2 g at 6,275 individuals were recorded in the whole sampling area. The maximum biomass was 228.5 g/m² at the station B 9 at 3,297 ind./m² for *M. phaseolina* and 748.5 g/m² at the station B8 at 2,526 specimens/m² for *Mytilus galloprovincialis*. According to ARNOLDY (1941; cf. ZENKEVICH, 1963), in the small area of the southern coasts of the Crimea (from Cape Fiolent to Alupka), the mean biomass of *Modiolula phaseolina* was 779 g/m² at 10,700 ind./m² and that of *Mytilus galloprovincialis* was 464 g/m² at 185 ind./m². These data also closely follow WODJANITZKY's result (cf. ZENKEVICH, 1963). In the phaseolin mud (60-180 m) the density of *Modiolula phaseolina* population was several hundreds per square meter (SOROKIN, 1983). In the Rumanian Black Sea coasts at Mamaia, under conditions of eutrophication, the mytilid mussel was found to have the maximum values of 1,510 ind./m² at the biomass of 29.08 g/m² (GOMOIU, 1988). MARINOV & GOLEMANSKY (1988) reported that the average biomass of *Modiolula phaseolina* was 710 g/m² and the abundance 11000 ind./m² or more on the bottom deeper than 60 m along the Bulgarian littoral zone. The average specimen number of *M. phaseolina* was recorded to be 10,000 ind./m² on the continental shelf of the Black Sea (KARANDIEVA, 1959; cf. BACESCU & ACAD, 1971). But the mussel bed decreased since the presence of its predator, *Rapana venosa* along the Bulgarian continental shelf (MARINOV, 1987). The maximum number of spe-

cimens reached 1,500 specimens/m² at 60 to 75 m and the greatest biomass 2,000 g/m² at 35 to 50 m along the Anatolian coasts (NIKITIN, 1938 cf. ZENKEVICH, 1963).

On the sandy and silty bottom, the predominant species were *Lucinella divaricata* of 1,891 ind./m² at the biomass of 110.2 g/m² *Chamelea gallina* of 354 ind./m² at the biomass of 26.9 g/m² (20 m, station B20) and *pitar rudis* of 1,131 ind./m² at of the biomass of 48.3 g/m² (28 m, station B14) in the studied area. On sandy and silty bottoms of the Caucasian coasts, *L. divaricata* was found to have the mean value of 858 ind./m² and 5.8 g/m² at depths of 15-30 m. The mean specimens number and biomass for *Chamelea gallina* was 248 ind./m² and 5.8 g/m² on the silty sand bottom. In the present study, *Donax venustus* was observed with a biomass of 8.6 g/m² and 86 ind./m² only at station B20 at which the bottom contained 93% of sand, off Rize in the Turkish coasts. ZENKEVICH (1963) calculated, from the ARNOLDY's data, that the average specimens number and biomass of this species was 21 ind./m² and 6.7 g/m² in the coastal pure sand off Caucasian in the Black Sea.

Although *Abra alba* and *Plagiocardium papillosum* were the representative of the most frequent mollusc species in the Anatolian coasts, however, the abundance and the biomass of them was very low compared with the other bivalves.

Abra alba is a common bivalve of the Black Sea and inhabits particularly the soft bottom after 40 m depth. *Plagiocardium papillosum* lives also at the same depth in the Black Sea (CASPER, 1957). In this study, these species were found to have the following maximum values: the specimens number and biomass of *Abra alba* were 131 ind./m² and 2.2 g/m² at the depth of 44 m (station B6), while they were 126 ind./m² and 2.6 g/m² at the depth of 48 m (station B15), for *C. papillosum* in the Anatolian coasts. On the mussel mud (30-50 m) in the Caucasian coasts, the mean biomass and abundance of these species were as follows: 10 g/m² at 63 specimens/m² for *Plagiocardium papillosum* and 4.5 g/m² at 47 ind./m² for *Abra alba* (ZENKEVICH, 1963). *Abra alba* was observed to have 130 ind./m² at the depth of 50 m off Constanta in Rumania. *Plagiocardium papillosum* was found to be 20 ind./m² at 47 m and 10 ind./m² at the depth of 63 m in the Constanta coasts, but 200 ind./m² at depths of 100-170 m off Bosphorus in the Black Sea (BACESCU et al., 1971).

Conclusion

Only two mollusc classes (Gastropoda: subclasses Prosobranchia, Opisthobranchia and Lamellibranchia: subclasses Pteromorpha, Heterodonta) were distinguished.

11 species of Gastropoda and 25 of Lamellibranchia were found. The total abundance of the molluscs along the Turkish coast of the Black Sea was found to be 25,674 specimens which had a total biomass of 2361 g. The individual number varies from 12 to 7858 ind./m², the species from 1 to 20 spp./m² and the biomass between 0.401 and 808 g/m² among the stations.

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